SOUTH CAROLINA Energy Office

Energy Briefs

Helping the Homeowner Live Energy Efficiently

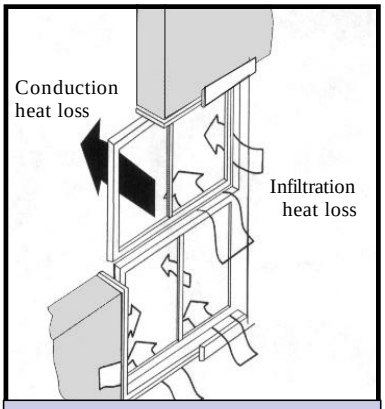
Energy-Efficient Windows

Windows bring light, warmth and beauty into buildings and give a feeling of openness and space to living areas. They can also be major sources of heat loss in the winter and heat gain in the summer. The U.S. Department of Energy estimates that 25 percent of the heating and cooling in the United States is lost through windows each year. However, when properly selected and installed, windows can help minimize a home's heating, cooling and lighting costs. The South Carolina Energy Code requires that double-pane windows or single-pane windows with storm windows be used on all residential buildings. Proof of compliance may also be shown using the CABO Model Energy Code (MEC) software if single-pane windows are used without storm windows. Your builder or architect should have the necessary software.

This publication describes two options, energy-efficient windows and window glazing materials, available for reducing a home's heating and cooling energy requirements.

Controlling Air Leaks

When air leaks around windows, energy is wasted. Energy is also transferred through the centers, edges and frames of windows. Eliminating or reducing these paths of heat flow can greatly improve the energy efficiency of windows and, ultimately, of homes. Several options are available to reduce air leaks around windows; the least expensive options are caulking and weatherstripping, followed by replacing window frames.



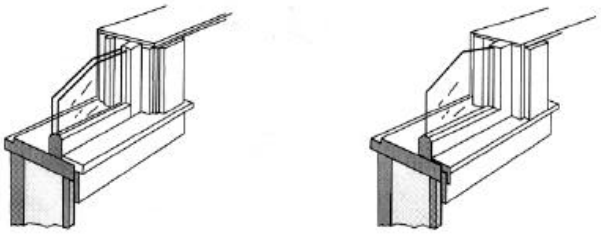
Heat escapes around loosely-fitted frames and through glass panes in windows.

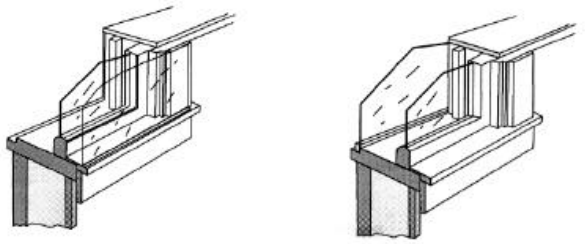
Caulking and Weatherstripping

Caulks are airtight compounds (usually latex or silicone) that fill cracks and holes. Before applying new caulk, old caulk or paint residue remaining around a window should be removed using a putty knife, stiff brush, or special solvent. After old caulk is removed, new caulk can then be applied to all joints in the window frame and the joint between the frame and the wall. The best time to apply caulk is during dry weather when the outdoor temperature is above 45 degrees F (7.2 degrees C). Low humidity is important during application to prevent cracks from swelling with moisture. Warm temperatures are also necessary so the caulk will set properly and adhere to the surface.

Weatherstripping is a narrow piece of metal, vinyl, rubber, felt or foam that seals the contact area between the fixed and movable sections of a window joint. It should be applied between the sash and the frame but should not interfere with the operation of the window. For more information on caulking and weatherstripping, contact the South Carolina Energy Office.

South Carolina Energy Office * 1201 Main Street, Suite 1010 * Columbia, SC 29201
(803) 737-8030 * 1-800-851-8899 * Fax (803) 737-9846 * http://www.energy.sc.gov





Double-pane windows are usually more efficient than single-pane or storm windows.

Types of Glazing Materials

Traditionally, clear glass has been the primary material available for window panes in homes. However, in recent years, the market for glazing - or cutting and fitting window panes into frames - has changed significantly. Now several types of special glazings are available that can help control heat loss, heat gain and condensation.

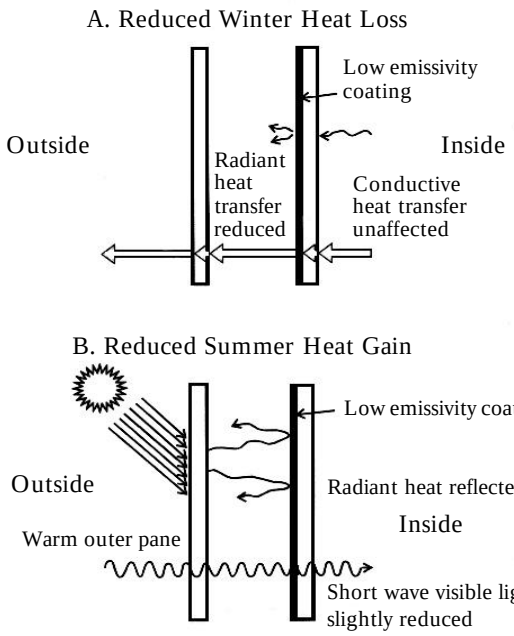
Low-emissivity (low-e) glass has a special surface coating to reduce heat transfer through the window. These coatings reflect from 40 to 70 percent of the heat normally transmitted through clear glass, while allowing the full amount of light to pass through.

The coatings are thin, almost invisible metal oxide or semiconductor films placed directly on one or more surfaces of glass or on plastic films between two or more panes. The coatings typically face air spaces within windows and reduce heat flow between the panes of glass.

When applied inside a double-pane window, the low-e coating is placed on the outer surface of the inner pane of glass to reflect heat back into the living space during the heating season. This same coating will slightly reduce heat gain during the cooling season.

Low-e films are applied in either soft or hard coats. Soft-coat low-e films degrade when exposed to air and moisture, are easily damaged, and have a limited shelf life, so they are carefully applied by manufacturers in insulated multiple-pane windows. Hard low-e coatings, on the other hand, are more durable and can be used in add-on (retrofit) applications. But the energy performance of hard-coat low-e films is slightly poorer than that of soft-coat films. Windows manufactured with low-e films typically cost about 10 to 15 percent more than regular windows, but they reduce energy loss by as much as 30 to 50 percent.

Although low-e films are usually applied during manufacturing, retrofit low-e window films are also widely available for do-it-yourselfers. These films are inexpensive compared to total window replacements, last 10 to 15 years without peeling, save energy, reduce fabric fading, and increase comfort.



Low-e glazings reduce radiant heat transfer.

Layers of Glass and Air Spaces

Standard single-pane glass has very little insulating value (approximately R-1). It provides only a thin barrier to the outside and can account for considerable heat loss and gain. Traditionally, the approach to improve a window's energy efficiency has been to increase the number of glass panes in the unit, because multiple layers of glass increase the window's ability to resist heat flow.

Double- or triple-pane windows have insulating air- or gas-filled spaces between each pane. Each layer of glass and the air spaces resist heat flow. The ideal width of air spaces is between 1/2 and 5/8 inches. The width of the air spaces between the panes is important, because air spaces that are too wide (more than 5/8 inch or 1.6 centimeters) or too narrow (less than 1/2 inch or 1.3 centimeters) have lower R-values (i.e., they allow too much heat transfer). Advanced, multi-pane windows are now manufactured with inert gases (argon or krypton) in the spaces between the panes because these gases transfer less heat than does air.

Multi-pane windows are considerably more expensive than single-pane windows and limit framing options because of their increased weight.

Frame and Spacer Materials

Window frames are available in a variety of materials including aluminum, wood, vinyl and fiberglass. Frames may be primarily composed of one material, or they may be a combination of different materials such as wood clad with vinyl or aluminum-clad wood. Each frame material has its advantages and disadvantages.

Though ideal for strength and customized window design, **aluminum frames** conduct heat and therefore lose heat faster and are prone to condensation. Through anodizing or coating, the corrosion and electro-galvanic deterioration of aluminum frames can be avoided. Additionally, the thermal resistance of aluminum frames can be significantly improved by placing continuous insulating plastic strips between the interior and exterior of the frame.

Wood frames have higher R-values, are not affected by temperature extremes, and do not generally promote condensation. Wood frames do require considerable maintenance in the form of periodic painting or staining. If not properly protected, wood frames can swell, which leads to rot, warping and sticking.

Vinyl window frames, which are made primarily from polyvinyl chloride (PVC), offer many advantages. Available in a wide range of styles and shapes, vinyl frames have moderate to high R-values, are easily customized, are competitively priced, and require very low maintenance. While vinyl frames do not possess the inherent strength of metal or wood, larger-sized windows are often strengthened with aluminum or steel reinforcing bars.

Fiberglass frames are relatively new and are not yet widely available. With some of the highest R-values, fiberglass frames are excellent for insulating and will not warp, shrink, swell, rot or corrode. Unprotected fiberglass does not hold up to the weather and therefore is always painted. Some fiberglass frames are hollow, while others are filled with fiberglass insulation.

Spacers are used to separate multiple panes of glass within the windows. Although metal (usually aluminum) spacers are commonly installed to separate glass in multi-pane windows, they conduct heat. During cold weather, the thermal resistance around the edge of a window is lower than that in the center; thus, heat can escape and condensation can occur along the edges. To alleviate these problems, one manufacturer has developed a multi-pane window using a 1/8-inch-wide (0.32 centimeters-wide) PVC foam separator placed along the edges of the frame. Like other multi-pane windows, these use metal spacers for support, but because the foam separator is secured on top of the spacer between the panes, heat loss and condensation are reduced. Several window manufacturers now sandwich foam separators, nylon spacers, and insulation materials such as poly-styrene or rockwool between the glass inside their windows.

Additional Options for Reducing Heat Loss and Gain through Windows

Movable insulation, such as insulating shades, shutters and drapes, can be applied on the inside of windows to reduce heat loss in the winter and heat gain in the summer. Shading devices, such as awnings, exterior shutters, or screens, can be used to reduce unwanted heat gain in the summer.

In most cases, these window treatments are more cost-effective than energy-efficient window replacements and should be considered first. Additional information on window treatments is available from EREC (see Source List on page 6).